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# मानक

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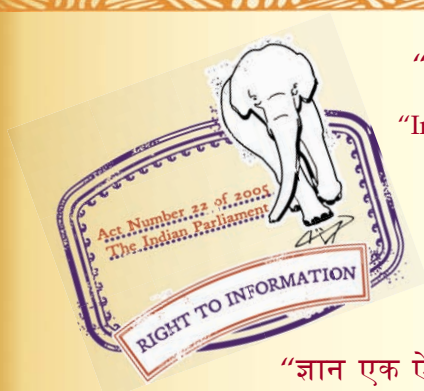
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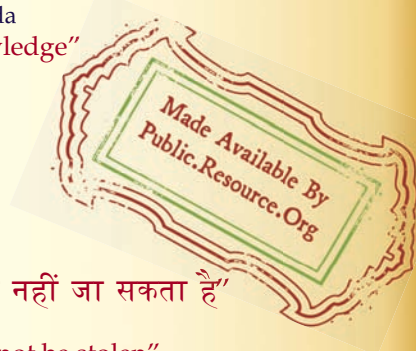
IS 4531-1 (1988): Swivels, Part 1: General Requirements  
[MED 14: Cranes, Lifting Chains and Related Equipment]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



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*Indian Standard*  
**SPECIFICATION FOR  
SWIVELS**

**PART 1 GENERAL REQUIREMENTS**

*( First Revision )*

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**BUREAU OF INDIAN STANDARDS**  
**MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG**  
**NEW DELHI 110002**

# *Indian Standard*

## SPECIFICATION FOR SWIVELS

### PART 1 GENERAL REQUIREMENTS

### ( *First Revision* )

#### 0. FOREWORD

**0.1** This Indian Standard ( Part 1 ) ( First Revision ) was adopted by the Bureau of Indian Standards on 27 January 1988, after the draft finalized by the Lifting Chains, Associated Fittings and Components Sectional Committee had been approved by the Marine, Cargo Movement and Packaging Division Council.

**0.2** This standard, first issued in 1968, is being revised to align with the current manufacturing practices. Also, in this revision, the standard has been split into three parts. Part 1 covers the general requirements of swivels including material, workmanship, tests and marking details. It also includes guidelines for the design of swivels in Appendix A. The dimensional requirements for bowpiece and eye ( round and elongated with ball/plain bearing ) are separately covered in Part 2 and Part 3, respectively.

**0.3** The swivels in each series are geometrically similar and are designed in accordance with appropriate limiting stresses ( *see* Appendix A ). For practical reasons, the same bowpiece covered in Part 2 of this standard, is used for both the ball bearing and the plain bearing swivels.

**0.4** The reliability of swivels is an important factor and, therefore, it is recommended that the supply should be obtained from manufacturers possessing adequate facilities for heat treatment

and testing equipment and employing competent staff for inspection.

**0.5** Users are warned that the swivels shall not be taken as complying with this standard unless specified tests have been made and the test requirement obtained in the presence of a person representing or approved by the purchaser.

**0.6** The information to be supplied with the enquiry and order is given in Appendix B.

**0.7** While the swivels in common use have been covered under the standard, there are many other types of swivels for other uses. Guidance for design of these types of swivels is given in Appendix A.

**0.8** In the preparation of this standard, considerable assistance has been derived from BS 4283 : 1968 'Specification for swivels for lifting purposes', issued by the British Standards Institution ( BSI ).

**0.9** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

\*Rules for rounding off numerical values ( *revised* ).

#### 1. SCOPE

**1.1** This standard specifies the basic requirements of two types of swivels using ball bearing and plain bearing, each comprising a bowpiece and one of the three following means of supporting the load:

- a) A round eye,
- b) An elongated eye, or
- c) A 'C' type trapezoidal shank hook.

The swivels specified have safe working loads from 10 to 125 kN.

**1.1.1** Provision is made for special swivels ( *see* Appendix A ).

#### 2. TERMINOLOGY

**2.0** For the purpose of this standard, the following terminology shall apply.

**2.1 Competent Person** — A person who is approved and declared as such under the relevant statutory provisions.

**2.2 Processing** — Any treatment of different components of the swivel subsequent to forging such as heat treatment, polishing, etc.

**2.3 Proof-Load** — Proof-load is the load to which different components of the swivel shall be subjected in the finished condition.

**2.4 Rating** — The maximum safe working load which the swivel shall withstand.

#### 3. FORM AND DIMENSIONS

**3.1** The form of swivels shall be as given in Fig. 1.

**3.2 Bowpiece** — The form and dimensions of bowpiece used for both ball bearing and plain

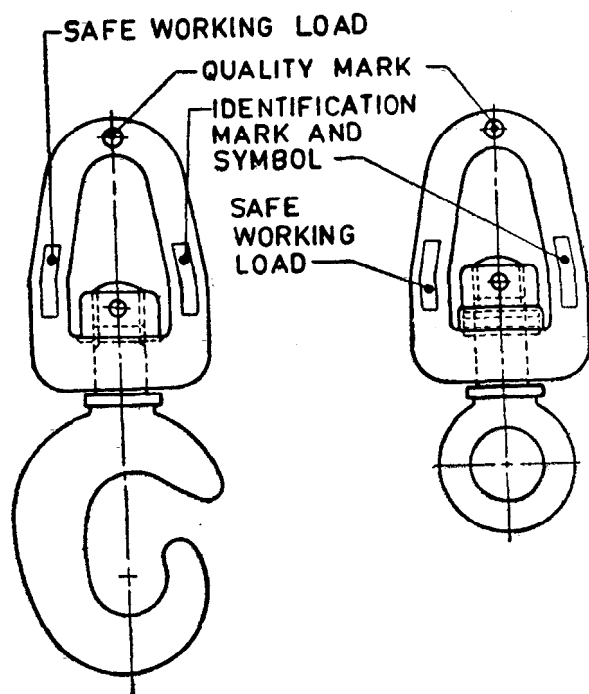


FIG. 1 ASSEMBLY OF SWIVEL

bearing swivels shall be as given in Part 2 of this standard.

**3.3 Eye** — The dimensions of round eye and elongated eye with ball bearing and plain bearing shall be as given in Part 3 of this standard.

**3.4** The dimensions of 'C' hook, where used, shall conform to the requirements of IS : 3813-1967\*.

### 3.5 Tolerances

**3.5.1** Quality 'close' tolerances as covered in IS : 3469 ( Part 2 )-1974† shall be applied to drop forging dimensions.

**3.5.2 Shank** — The tolerance on the machined shank shall be  $-0.08$  to  $-0.25$  mm. A plus allowance shall be made when forging the shank to allow for machining to the required diameter. The nominal diameter of the shank and of the bore in the bowpiece shall be subject to the following tolerances:

For the shank	$-0.08$ to $-0.25$ mm
For the bore in the bowpiece:	
Up to and including 20 mm diameter hole	$+1.0$ mm $-0$
Over 20 mm diameter hole, up to and including 45 mm diameter hole	$+1.2$ mm $-0$
Over 45 mm diameter hole	$+1.6$ mm $-0$

\*Specification for 'C' hooks for use with swivels.

†Tolerances for closed die steel forgings (first revision).

The junction of the shank and the collar shall be radiused.

## 4. MATERIAL

**4.1** The steel used for the manufacture of swivel shall conform to Class 3 of IS : 1875-1978\* or equivalent.

**4.1.1** The combined percentage of sulphur and phosphorus in the steel shall not exceed 0.09.

**4.2** When so required by the purchaser, the manufacturer shall supply a copy of steel maker's analysis.

## 5. HEAT TREATMENT AND WORKMANSHIP

**5.1** All bowpieces, round eyes, elongated eyes and hooks shall be subjected to one of the following heat treatments:

- Normalizing by heating to a temperature within  $50^{\circ}\text{C}$  above the upper critical point of the steel used,  $860$  to  $890^{\circ}\text{C}$  in case of Class 3 steel to IS : 1875-1978\*, followed by cooling in still air.
- Hardening and tempering by heating to a temperature within  $50^{\circ}\text{C}$  above the upper critical point of the steel used, followed by quenching in oil or water and tempering at a suitable temperature between  $550$  to  $660^{\circ}\text{C}$ .

### 5.2 Workmanship

**5.2.1** The bowpieces, round eyes, elongated eyes and hooks shall be cleanly drop-forged and shall be free from defects.

**5.2.2** The hole in the bowpiece shall be machined and the bearing face for the nut shall be machined in true alignment with the hole, and the outer end of the hole shall be countersunk to accommodate the fillet between the body and the shank of the eye or hook.

**5.2.3** The hook shall be forged in such a manner that the microscopic flow lines follow, as nearly as possible, the body outline of the hook. The whole of the shank shall be forged in one piece integral with the hook.

**5.2.4** All shanks shall turn freely by hand, before and after proof loading. The clearance between the bowpiece and the collar of the eye or hook unloaded shall not exceed  $0.1$  mm.

### 5.3 Screw Threads and Shank Nuts

**5.3.1** The screw threads in the shank of the round eyes, elongated eyes or 'C' hooks shall be of Class 8g (free fit) conforming to IS : 4218-1976†.

**5.3.1.1** The portion of the shank at the end of the screw thread shall be an undercut and fillet

\*Specification for carbon steel billets, blooms, slabs and bars for forgings (fourth revision).

†Specification for ISO metric screw threads.

in accordance with the appropriate requirements of IS : 1369-1982\*.

**5.3.1.2** The shank and nut which secures it shall be drilled to take a retaining pin and there shall be a continuous length of shank engaged by the nut on the load side, at least equal to two-thirds of the diameter at the top of the thread.

**5.3.2 Shank Nuts** — A machined circular nut shall be fitted to the screwed shank, the depth being not less than the full diameter of the screwed shank. The nut shall screw down on to the undercut and shall be secured by means of a retaining pin.

**5.4 Hardness** — Bowpieces, round eyes, elongated eyes and 'C' hooks shall have a Brinell hardness between 163 and 217. The test shall be made, where practicable, in accordance with IS : 1500-1983† using a 10 mm ball and a load of 3 000 kg. The surface on which the impression is to be made shall be obtained by filing, grinding or smooth machining. Suitable precautions should be taken to ensure that the surface tested is representative of the material and that its hardness is not affected by decarburization, carburization, or by the method used for the preparation of test surface.

## 6. RATING AND PROOF LOADING

**6.1** The swivels shall be rated according to the safe working load given below:

### *Safe Working Load*

kN
10
12.5
16
20
25
32
40
50
63
80
100
125

**6.2** Each swivel after manufacture and subsequent heat treatment shall be subjected to a proof load equal to twice the safe working load given under 6.1, which it shall withstand without showing any visible permanent set.

**6.2.1** After the removal of the proof load, each swivel shall be thoroughly examined by a competent person, and shall be accepted only if found free from visible flaw or defect.

\*Dimensions for screw thread runouts and undercuts (second revision).

†Method for Brinell hardness test for metallic materials (second revision).

## 7. TESTING FACILITIES

**7.1** The manufacturer shall provide the necessary facilities required for tests in accordance with this standard. In the absence of such facilities at his own works for the specified test (see 6), the manufacturer shall bear the cost of proof loading by a recognized testing laboratory.

**7.2 Additional Test** — If the purchaser requires tests or chemical analysis of the material or additional tests on finished swivels these requirements shall be clearly stated in enquiry and order, and, if so desired, the samples shall be selected by a person representing or approved by the purchaser.

## 8. INSPECTION

**8.1** The representative of the purchaser shall have access to the works of the manufacturer at any reasonable time. He shall be at liberty to inspect the swivels at any stage of manufacture and the methods of examination.

## 9. MARKING

**9.1 Quality Marking** — The bowpieces of each swivel shall be legibly and permanently marked with the symbol '04' when in the hardened and tempered condition, and with the symbol '4' when normalized. The mark shall be enclosed in a circle (see 9.2).

**9.2 Identification Marking** — Each swivel shall be permanently and legibly marked with the safe working load as given under 6.1, at positions shown in Fig. 1 and also with such marks and symbols as will allow identification with the manufacturer's certificate of test and examination (see Appendix C). The stamps should have a concave surface and the indentations should be neither too sharp nor excessive in depth. The recommended sizes of stamps shall be as given below:

<i>Diameter of Material in Bowpieces</i>	<i>Size of Mark</i>
mm	mm
Up to and including 25	5
Over 25	6.5

**9.2.1** The swivels may also be marked with the Standard Mark.

**NOTE** — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

## APPENDIX A

( *Clauses 0.2, 0.3, 0.7 and 1.1.1* )

## GUIDANCE ON DESIGN OF SWIVELS

## A-1. GENERAL

**A-1.1** In the design of swivels, the safe working load should be based on either the strength of the screwed shank, related to the limiting average tensile stress on core diameter area of the screwed portion; or on the strength of the bowpiece, elongated eye, round eye, or hook body, related to the limiting extreme fibre ( tensile ) stress at the extrados fibres or intrados fibres. Swivels whose dimensions differ from those covered in Parts 2 and 3 of this standard may be designed as special swivels in accordance with the following requirements.

## A-2. SCREWED SHANKS

**A-2.1** The safe working load of the screwed shank should be based on average tensile stress on core diameter area which should not exceed 63 MPa when the safe working load is up to and including 40 kN nor 70 MPa when the safe working load exceeds 40 kN. In no case the depth of the thread be less than 0.040 times the outside diameter of the screwed thread nor the length of the screwed portion less than that covered in the tables given in Parts 2 and 3 of this standard.

## A-3. THRUST BEARINGS

**A-3.1** When thrust bearings are required, they should be selected in accordance with the following requirements:

- a) The basic static load rating of a thrust bearing for a swivel should not be less than the safe working load of the swivel, or two-thirds of the proof load, whichever is the greater.
- b) The basic static load rating is that static, central thrust load which corresponds to a total permanent deformation of ball and race at the most heavily stressed contract, set at 0.000 1 of the ball diameter.

c) Values of these load ratings for specific bearing types and sizes can be obtained from the bearing manufacturers who should also be consulted where the duties are unusually intensive.

d) A dust cap should be fitted to protect the bearing.

## A-4. BOWPIECE, ROUND EYE AND ELONGATED EYE

**A-4.1** The safe working load of a bowpiece, round eye, or elongated eye shall be based on nominal extreme fibre ( tensile ) stress at the safe working load, and may be taken as:

$$W = 10 K d^2 \text{ kN}$$

where

$W$  = safe working load, kN;

$d$  = diameter of material in bowpiece, round eye, or elongated eye, mm; and

$K$  = numerical coefficient, depending upon the ratios:

$\frac{L}{d}$  and  $\frac{B}{d}$  for a bowpiece or for an elongated eye, and

$\frac{D}{d}$  and  $\frac{F}{d}$  for a round eye (For symbols, see appropriate Fig. 2, 3 or 4 ).

The values of  $K$  may be obtained from Fig. 2 to 4.

NOTE — The values of  $K$  in Fig. 2 relate to bowpiece with parallel sides. The values of  $K$  for the tapered bowpieces are slightly greater but this improvement is unlikely to exceed 5 percent and has, therefore, been neglected in the table of bowpiece dimensions given in Part 2 of this standard.

## APPENDIX B

( *Clause 0.6* )

## INFORMATION TO BE SUPPLIED WITH ENQUIRY AND ORDER

**B-1.** The enquiry and order should state:

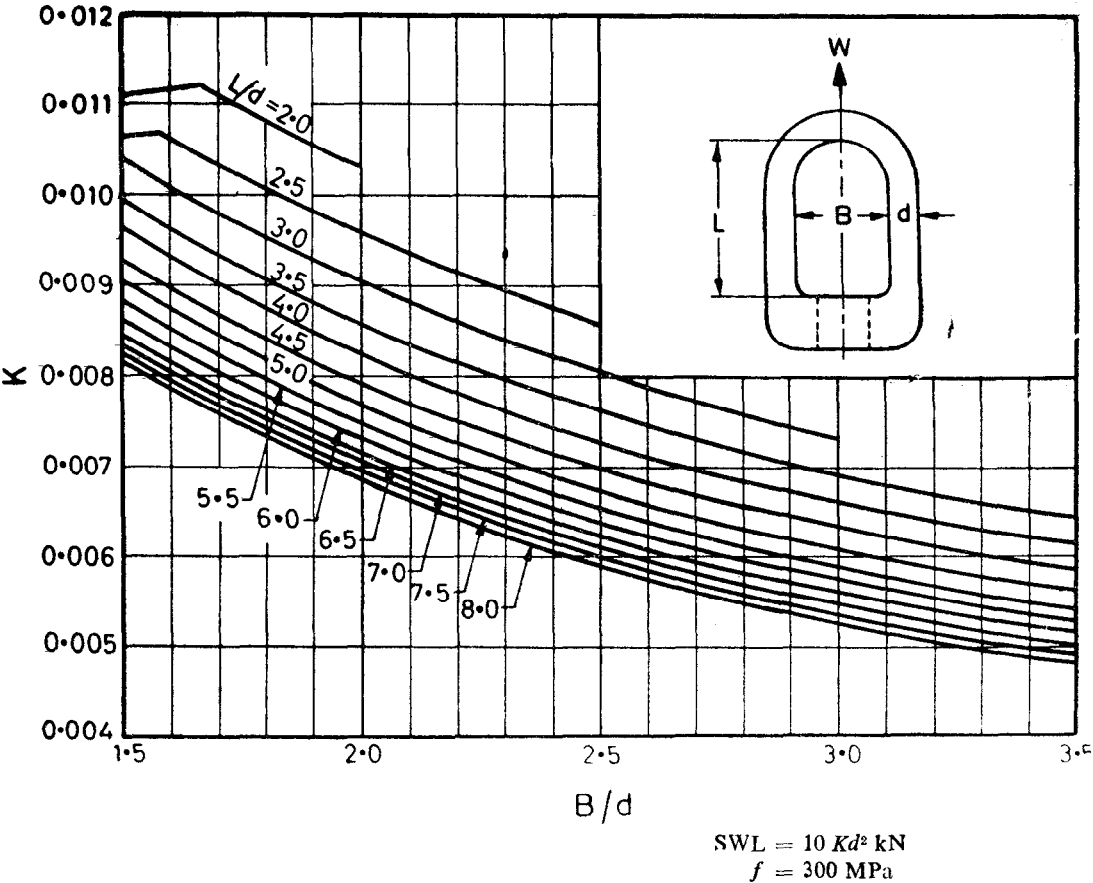
a) Type of swivel,

b) Safe working load ( *see 6.1* ),

c) Heat treatment required, and

d) Further tests or chemical analysis required.





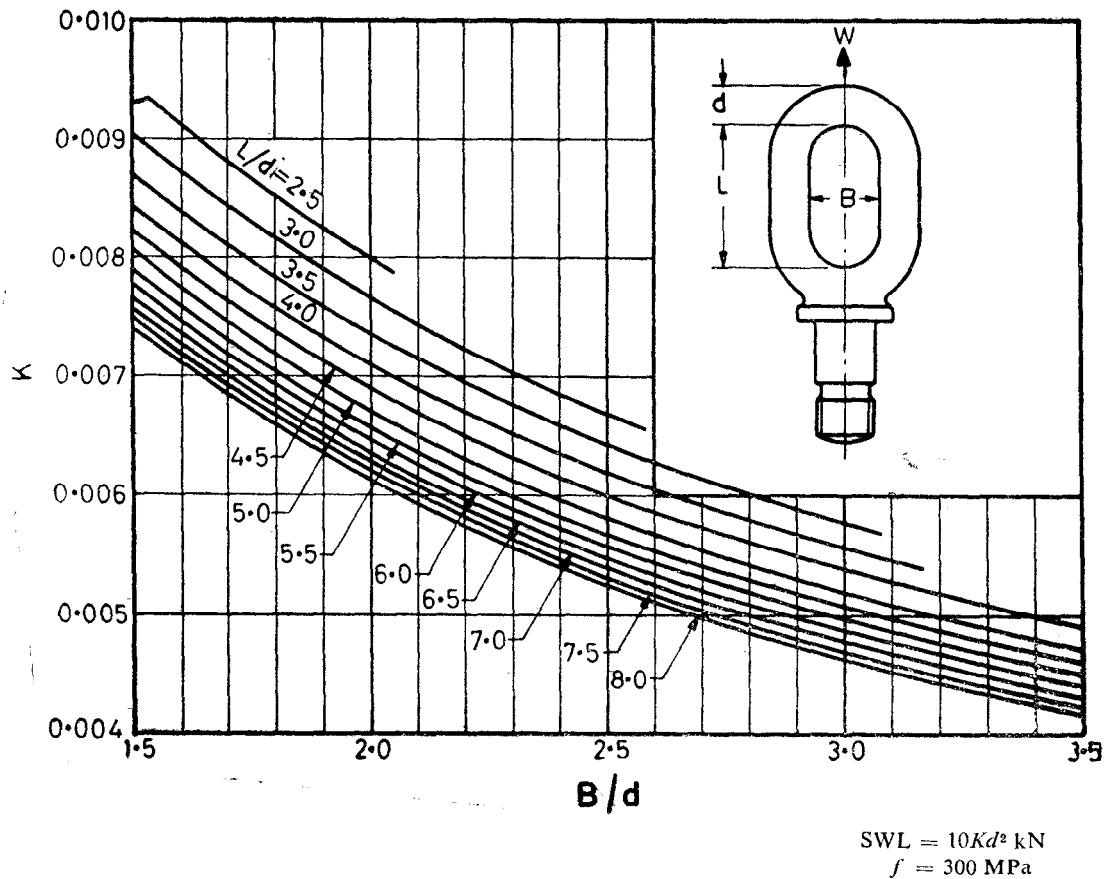
$\frac{L}{d}$	$\frac{B}{d}$					
	1.5	1.7*	2.0	2.5	3.0	3.5
2.0	K 0.011 08	K 0.011 25	K 0.010 27	—	K —	K —
2.5	0.010 65	0.010 72	0.009 56	0.008 58	—	—
3.0	0.010 42		0.009 00	0.008 04	0.007 35	—
3.5	0.009 99		0.008 56	0.007 61	0.006 93	0.006 42
4.0	0.009 66		0.008 20	0.007 26	0.006 59	0.006 09
4.5	0.009 30		0.007 94	0.006 98	0.006 31	0.005 81
5.0	0.009 04		0.007 66	0.006 72	0.006 07	0.005 58
5.5	0.008 82		0.007 45	0.006 53	0.005 87	0.005 38
6.0	0.008 62		0.007 27	0.006 36	0.005 71	0.005 22
6.5	0.008 55		0.007 11	0.006 20	0.005 56	0.005 07
7.0	0.008 44		0.006 97	0.006 07	0.005 43	0.004 94
7.5	0.008 34		0.006 89	0.005 95	0.005 31	0.004 83
8.0	0.008 23		0.006 82	0.005 85	0.005 21	0.004 73

NOTE — Values above the dividing lines indicate maximum tensile stress at intrados fibres, and values below, at extrados fibres.

\*These additional values are given to facilitate the plotting of curves.

All dimensions in millimetres.

FIG. 2 VALUES OF DESIGN COEFFICIENT K FOR BOWPIECES

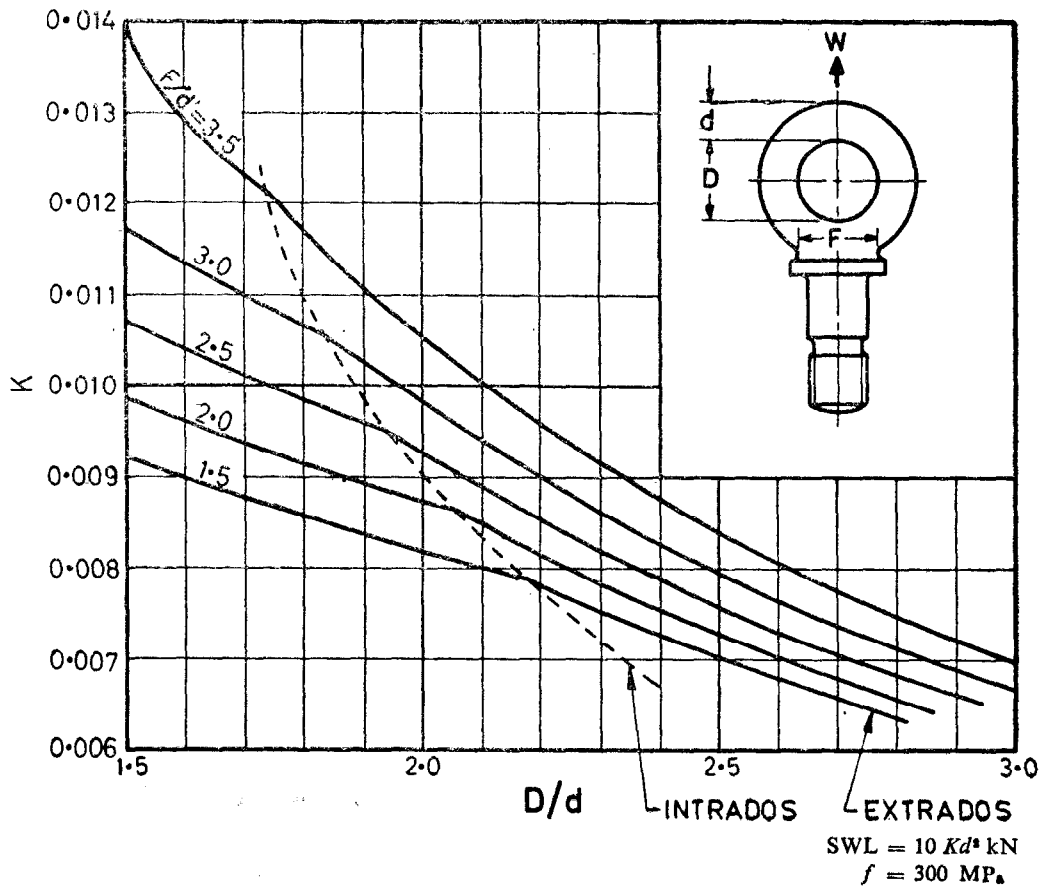


$\frac{L}{d}$	$\frac{B}{d}$				
	1.5	2.0	2.5	3.0	3.5
	$K$	$K$	$K$	$K$	$K$
2.5	0.009 30	0.008 01	—	—	—
3.0	0.009 02	0.007 65	0.006 70	—	—
3.5	0.008 71	0.007 36	0.006 45	0.005 80	—
4.0	0.008 48	0.007 10	0.006 21	0.005 56	—
4.5	0.008 26	0.006 91	0.006 01	0.005 37	0.004 90
5.0	0.008 08	0.006 74	0.005 84	0.005 21	0.004 73
5.5	0.007 93	0.006 59	0.005 71	0.005 08	0.004 60
6.0	0.007 81	0.006 48	0.005 60	0.004 96	0.004 48
6.5	0.007 72	0.006 38	0.005 49	0.004 86	0.004 39
7.0	0.007 64	0.006 29	0.005 40	0.004 78	0.004 30
7.5	0.007 55	0.006 21	0.005 32	0.004 70	0.004 23
8.0	0.007 48	0.006 16	0.005 25	0.004 63	0.004 16

NOTE — The value above the dividing line indicates maximum tensile stress at intrados fibres, and the values below, at extrados fibres.

All dimensions in millimetres.

FIG. 3 VALUES OF DESIGN COEFFICIENT  $K$  FOR ELONGATED EYES



	$\frac{D}{d}$				
	$\frac{F}{d}$				
	1.5	2.0	2.5	3.0	3.5
1.5	K 0.009 18	K 0.009 87	K 0.010 69	K 0.011 71	K 0.014 02
1.6	0.008 95	0.009 60	0.010 38	0.011 34	0.012 88
1.7	0.008 73	0.009 37	0.010 13	0.011 02	0.012 30
1.8	0.008 54	0.009 15	0.009 83	0.010 66	0.011 71
1.9	0.008 34	0.008 92	0.009 56	0.010 28	0.011 11
2.0	0.008 17	0.008 70	0.009 31	0.009 84	0.010 54
2.1	0.007 98	0.008 49	0.008 92	0.009 41	0.010 04
2.2	0.007 78	0.008 17	0.008 54	0.009 01	0.009 59
2.3	0.007 53	0.007 84	0.008 21	0.008 62	0.009 18
2.4	0.007 27	0.007 65	0.007 88	0.008 28	0.008 77
2.5	0.007 03	0.007 29	0.007 60	0.007 97	0.008 42
2.6	0.006 79	0.007 03	0.007 32	0.007 67	0.008 10
2.7	0.006 54	0.006 78	0.007 06	0.007 39	0.007 78
2.8	0.006 34	0.006 56	0.006 83	0.007 12	0.007 48
2.9	—	—	0.006 60	0.006 88	0.007 22
3.0	—	—	—	0.006 65	0.006 97

NOTE — Values above the dividing lines indicate maximum tensile stress at intrados fibres, and values below, at extrados fibres.

All dimensions in millimetres.

FIG. 4 VALUES OF DESIGN COEFFICIENT  $K$  FOR ROUND EYES

## APPENDIX C

( Clause 9.2 )

### MAKER'S CERTIFICATE

**C-1.** The manufacturer shall provide a certificate with each consignment of swivels, giving the following information for each:

- a) Distinguishing mark ( to enable the particular swivel to be identified ),
- b) Form of screw thread,
- c) Proof load applied,
- d) Safe working load, and

e) Details of heat treatment.

**C-2.** The certificate shall declare that each swivel was proof loaded in accordance with **6.2** and was subsequently examined by a competent person and that it complies with this standard.

**C-2.1** It shall state the name and address of the testing establishment and the status of the signatory.

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